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Abstract

Laboratory Research on Reprocessing of Irradiated Fuel in Czechoslovakia

Separation problems concerning the reprocessing of irradiated fuel have been studied on a laboratory scale in recent years, at the Nuclear Research Institute Czech.Acad.Sci. Following methods were used: liquid-liquid extraction, sorption on organic and inorganic ion exchangers, co-precipitation, the formation of radiocolloids and the distillation of fluorides.

In the field of liquid-liquid extraction, ketones were systematicaly studied and a more detailed research of the countercurrent extraction by means of methylcyklohexanone was finished, especially in the acid-deficient medium. The influence of the chain length and several function groups containing phosphorus on the separation of uranium and plutonium from the fission products was investigated for a number of phosphoorganic compounds. The Taft linear relationship was successfully used for the correlation of the extraction ability of neutral organophosphates. Further studies were made on the synergic effect of the extraction of Pu (IV) (acid and neutral organophosphate systems) and the rare earth elements (TBP, TTA, lower alcohols).

The extraction separation of uranium from fission products by means of fatty acids (C_{16-18}) in the presence of liquid paraffine and the mechanism of zirconium extraction by means of benzene solutions of the fatty acids (C_{7-9}) (the formation of colloids particles in

organic phase, the co-extraction of radioisotope traces with macroquantities of ziconium) were studied. Further investigations were made on the extraction of caesium by means of nitrobenzene in the presence of dipikrylamine, polyjodides, iodobismuthate, tetraphenylborate and heteropolyacids and the extraction of ruthenium by means of fused naphtols and tetrachloromethane (RuO_4). Several masking agents were found that improved the separation of uranium, plutonium and zirkonium during TBP extraction.

Attention was paid to the separation of uranium from fission products in aqueous medium on a column packed with divinylbenzenepolystyrene saturated with TBP and to the separation of zirconium from an organic phase (TBP in benzene) on a silicagel saturated with water.

In the field of ion exchangers, the separation of uranium on organic ion exchangers with the function groups containing phosphorus as well as the influence of organic solvents admixtures in aqueous phase on the separation of rare earths on organic ion exchangers was investigated. The sorption of uranium, plutonium and some fission products on zirkonyl and uranyl phosphates was studied also from the point of view of the mechanism (the validity of the solubility product). Much effort was made for a systematic research of heteropolyacids as selective sorbents for caesium and also of heavy metals ferrocyanids, several of which were found convenient for the reverse sorption of caesium (the repeated sorption and desorption of caesium under dynamic conditions without the sorbent dissociation). The sorption of a number of long-lived fission products was investigated on iron and manganese hydroxides and the results were interpreted from the point of view of the hypothesis of sorption complexes formation.

The behaviour of zirconium microquantities was investigated in acid solutions (2M HNO_3) in the presence of phenylarsenic acid and Arsenazo III. Anomalously high sorption on different surface areas from such solutions can be explained by the formation of radiocolloids. The method of the elementary fluorine production and the hydrofluorination of uranium having been governed, the separation of volatile uranium fluorides and the fission products on sodium fluoride was studied. The mechanism of the reaction between the uranium hexafluoride and the sodium fluoride was explained.